Annual Report for FY 2004 to the Office of Naval Research, Processes and Prediction Division, Code 322B
SURA Coastal Ocean Observing and Predicting Program (SCOOP)

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LONG-TERM GOALS

The overarching goals of SURA's Coastal Ocean Observing and Prediction (SCOOP) program are to complement the efforts of Ocean.US by taking on the task of data integration at the national level. For coastal science, the SCOOP Program is extending SURA's footprint beyond the southeastern states. SURA aims to assure that emerging regional systems serve the broader needs of a truly integrated and coordinated system that will benefit the entire nation. SCOOP is building upon the Data Management and Communications (DMAC) plan developed by the Ocean.US DMAC Steering Committee. The DMAC plan lays out a strategy for integrating regional systems with a national backbone, however, implementation has yet to begin on a large scale. SURA leaders see the SCOOP Program as an opportunity to create a new paradigm in integrated coastal research.

OBJECTIVES

SCOOP will implement key elements of a distributed system for assessing and predicting environmental response to extreme events in the eastern U.S. coastal zone, from Canada to Mexico. For the near term, this continues to involve:

I. Development of new standards and protocols for data & information exchange consistent with the Ocean.US DMAC plan;

II. Implementation of existing standards and protocols that have developed in other communities, with special emphasis on Geographic Information Systems (GIS) and the Open GIS Consortium (OGC) specifications;

III. Application of "Grid" technologies – largely in the form of software/middleware applications from computer science – to establish secure and reliable connectivity between the distributed partners, and to facilitate collaborative activities;

IV. Deployment of the communications infrastructure – possibly involving hardware or cables for telemetry – that links ocean sensors operating in extreme environmental conditions to research labs and decision-makers who need timely information; and

V. Cultivation of industry partners who can integrate the infrastructure of a truly operational system that supports both research and applications.

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APPROACH

The SCOOP Program presently focuses on storm surge, wind waves and surface currents, with special attention to predicting and visualizing phenomena that cause damage and inundation of coastal regions during severe storms and hurricanes. Partners include university researchers and relevant NOAA, Navy and other federal agency program offices. The agency partnerships will facilitate the transition of well-tested research capabilities to an improved operational prediction system. SCOOP is emphasizing the transition of "pre-operational" research activities to operational status. This approach, which is the signature of SCOOP, is referred to as "interoperability" and is intended to help bridge the historical gap between research and operations. Each type of activity has its own set of goals and anticipated outcomes. It is the SCOOP mission to create an effective link between them and to intersect science leaders from the research community with operational leaders and user groups. This involves developing and implementing specific activities in numerical modeling, real-time data exchange, and 24/7 operational prediction and visualization.

WORK COMPLETED AND IN PROGRESS

Funding for first year of activity, FY 2003, was received in the latter half of FY2003, whereas funding for FY 2004 was received in July 2004. Therefore most of the progress to date pertains to FY 2003 activity; FY 2004 activities are now about two months underway. Utilizing the initial FY 2003 funds, SCOOP initiated three related initiatives:

1. A data-standards development process;

2. A "data grid" demonstration of interoperability at the data level based on Open GIS Consortium (OGC) standards for web services; and

3. A "model grid" demonstration of coupled storm-surge and wind-wave prediction models that employ "Grid" technologies based on standards from the Open Grid Services Architecture (OGSA).

These activities are near completion. It is intended that these three activities will merge into a seamlessly integrated system over the course of the ongoing FY 04 activity which is also being supported with significant funding from NOAA

1. ***Data Standards Development-FY 2003***
   In the area of data standards, work to date has involved two key elements. One was the demanding technical work associated with developing the standards themselves. The second involves community-building activities that create the buy-in necessary for the standards to be adopted and used. Standards development must be open and must involve the data providers and researchers. SURA has been coordinating with Ocean.US and NOAA for standards development.

2. ***Data Grid – Interoperability Demo-FY 2003***
   The SCOOP data grid project involves a partnership among the NOAA Coastal Services Center (CSC), DM Solutions Group (an IT consulting firm), and a variety of existing ocean observing programs around the country. These groups have worked together over the last six months to implement scalable and interoperable solutions based on *available* data standards. The primary accomplishment of the data grid is the creation of a website that demonstrates interoperability

using open GIS consortium (OGC) standards http://www.openioos.org/. Most recently this site has been updated with a new "hurricane version" of the demo.

3. ***Model Grid Demo-FY 2003***
   A significant activity in the first year focused on creating a modeling grid for linking storm surge and wave modeling efforts at multiple SURA universities. The aim was to demonstrate the value of the "Grid" as defined by the Open Grid Service Architecture (OGSA) standards.

4. ***Software modules for data transport - FY 2004 Plans –*** The objective of the SCOOP Transport Technology task is to initiate investigation and delineation of the data transport requirements for the coastal ocean community, both near-term and for future direction, identify and document the applicable existing protocols, interfaces, and standards tat will meet these needs and develop and produce software modules that provide data transport services among the various regional ocean observing systems. These modules are part of an integrated system. The modules are expected to (1) facilitate moving data from (a) sensor to archive; and, (b) facilitate moving data from archive to user; (2) facilitate data-on-demand and streaming data requests by end-users for data from archive sites; (3) facilitate adaptive data transfer, i.e., reliable data transfer will be provided in both bandwidth-limited and extreme environments, as well as high-bandwidth. Companion user manuals and training materials will also be provided. Mechanisms for archiving "raw" data will be assured.

5. ***FY 2004 Plans-Software modules for data translation & management.*** This project will initiate the integration of several existing ocean observing systems with heterogeneous and distributed data sources for both observations and model output. The resulting data grid will provide interoperability for data discovery across heterogeneous systems, translation from a data set's native format to that required for a particular application, and other related services. This will require leveraging existing capabilities and, when necessary, developing and producing software modules that provide data translation and management services, including discovery, for the data from various regional ocean observation systems (using a modular approach). These modules are part of an integrated system. The modules are expected to (1) provide for conversion between heterogeneous native data sets and standards; (2) provide a method to maintain the integrity of the original data, documents processing and provenance, and maintains trackability; (3) to the extent practicable, place the responsibility of documentation, metadata, translation services, etc., on the data provider or on the regional association. Companion user manuals and training materials will be provided as a deliverable. A report on the algorithms used in the translation will be provided, with particular emphasis on design decisions and performance evaluation.

6. ***FY 2004 Plans-Modeling subsystem – Nested Modeling: Model-Model Exchange Interface.*** This project will require model to model interaction utilizing distributed data management for collecting, archiving, and providing access to data; a web -based model portal interface; and model availability/execution in a Grid computing environment. The SCOOP initiative aims to create a modeling environment in which a set of coupled, large-scale, long wave and short wave models can be run in either a hindcast or an operational forecast mode. Users will be able to interact with these models via a web portal to (1) initiate specific runs of interest (2) provide a high resolution local models that "plug into" the large scale models, and (3) receive coupled model output and available observational data, either in digital format or as graphical displays, in specified areas at times of interest.

7. ***FY 2004 Plans*- Visualization services (client & server).** This project will develop visualization services that can translate the gridded output data produced by the data assimilation and modeling subsystem into images, data maps, time series plots, etc. Candidate software will transform the model data into GIS-format vector data and images. Visualization software will be implemented as a web-enabled data display consistent with the demonstration site at http://www.ioos.org with extension of the demonstration to include additional OpenGIS Web Services. Companion user manuals and training and demonstration materials will also be provided.

8. ***FY 2004 Plans-Computing and storage resources*.** This project will identify hardware and software requirements for the Grid, taking into account the modeling, Grid and security activities. The SCOOP Grid will be built based on these requirements to provide a Grid and collaborative portal for the SCOOP project. The project will work toward the creation of the SCOOP Grid, which includes accommodation for redundancy, reliability, quality of services, etc., however it is anticipated that full implementation is too ambitious for the first year.

9. ***FY 2004 Plans – Web Mapping Demonstration***. This project will develop a list of the potential data products t hat can be added to the http://www.openioos.org/ site and the issues associated with getting them there. Hurricane Ivan will be used as a test case using all applicable data products from the SCOOP modeling partners. The deliverable will be a tool that takes net CDF output from ADCIRC and publish to the OGC specs.

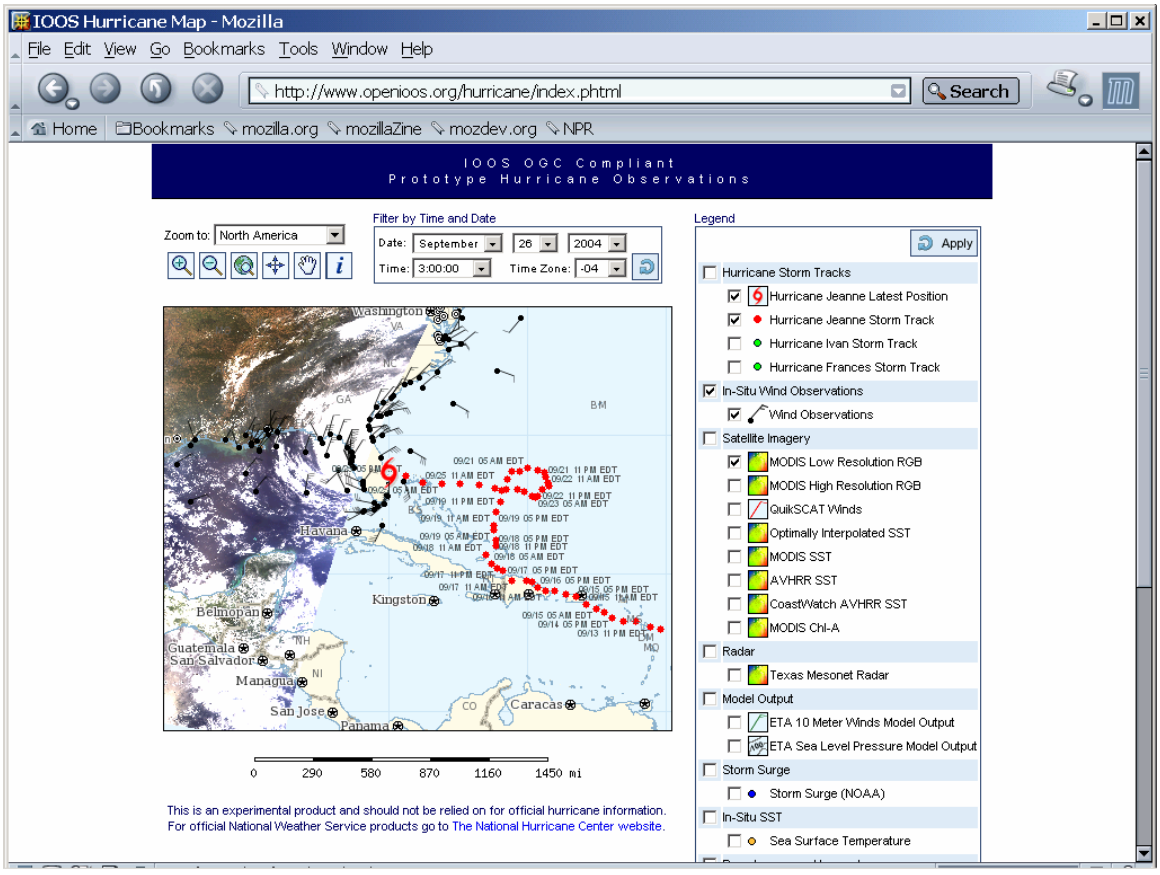

Figure 1. The http://www.openioos.org website demonstrating the data streams available and showing the track and position of hurricane Jeanne, wind observations, and MODIS satellite data.

10. ***FY 2004 Plans –Regional Association Data Grid***. SCOOP will support three nascent Regional Associations (RAs) of stakeholders (MARA, GoMOOS, GCOOS) as defined by Ocean.US to develop products and services tailored to the unique needs of each region that conform to the DMAC standards. Each RA will conduct a needs assessment and provide a report outlining the process used for needs assessment. The report will document the findings and requirements for an information product. During the course of the project each RA will develop an information product based on a partnership as appropriate with other RA data centers and provide a web- accessible information product. The product will be reviewed by representatives from the targeted user sector and revised as necessary to meet their needs. The final deliverable will be a report documenting the user-sector response, lessons learned and technical issues encountered.

11. ***FY 2004 Plans – COSEE Program Integration.*** The COSEE Program's web presence currently consists of a disparate collection of seven individually designed and maintained regional websites, a password protected administrative site, and a web page maintained by a Central Coordinating Office (CCO) that links to other sites (hhtp://www.cosee.net/). To maximize all available information to the COSEE network and its prospective users, the project will create a unified and coherent web presence.

RESULTS

Results obtained to date have been largely related to the completion of FY 2003 activities. Highlights are summarized as follows:

1. ***Data Standards Development-FY 2003***
   In February 2004, SURA and Ocean.US convened a meeting of metadata experts from around the country. The proposal that developed from that meeting contains specific deliverables that target some of the top priorities outlined in the DMAC plan. For community building, SCOOP, CSC and University of South Carolina sponsored an informal "OOS Tech" workshop on May 10 & 11. The workshop goals were to update the community on data-standards activities that occurred in the past year, and to promote an "open-source" attitude in the technical personnel that will be helping to create a distributed data system for the IOOS.

2. ***Data Grid – Interoperability Demo-FY 2003***
   SCOOP partners have exploited standards from the world of Geographic Information Systems (GIS). See the SURA wiki (http://twiki.sura.org) for a description of data-grid activities and lessons learned, and visit the interoperability demo web site (http://www.openioos.org) for an example of the data portal (with visualization) that uses the OGC protocols.

3. ***Model Grid Demo-FY 2003***
   The SCOOP Grid couples universities and operational agencies in data-intensive and computationally intensive collaborations. As a pilot first-year activity, scientists at University of Florida (UF), Louisiana State University (LSU) and Virginia Institute of Marine Science (VIMS) began a project to predict storm surge, surface waves and sediment transport with a series of coupled numerical model calculations. They are using a Grid implementation developed by the In-VIGO group at UF. In-VIGO users can log into the Grid via a web browser, call up an application (e.g., Matlab), apply a processing algorithm to data that reside on the Grid, and visualize the results through a simple browser-based user interface.

IMPACT/APPLICATIONS

The ***Preliminary Report of the U.S. Commission on Ocean Policy***, produced under the chairmanship of Admiral James Watkins and released in April, 2004, places a high priority on the build out of the Integrated Ocean Observing System (IOOS) in support of homeland security, sustainable economic development, quality of life and communication and education. The NOPP Strategic Plan calls for the interagency **Ocean.US** office, to "stabilize and integrate existing ocean observation programs to provide timely and sustained ocean data and data products with minimal gaps, affordable costs, and maximal utility." The SURA Coastal Ocean Observing and Prediction (SCOOP) program aims to complement the efforts of Ocean.US by taking on the task of integration at the national level. It is the intent of SCOOP to provide an infrastructure that will serve the entire ocean science and ocean operations community, scientists and operational users alike.